SOURCES OF INFORMATION FOR EDUCATORS

The North Carolina Biotechnology Center has a publication for educators that you may wish to order. "Carolina Genes," is an annual newsletter for North Carolina K-12 and college biology teachers. Every issue includes a feature article on an aspect of biotechnology and lesson plans, classroom activities and/or labs that relate to it. The newsletter also includes news about new biotechnology developments in North Carolina.

To be added to the mailing list for this publication contact Dr. Lynn Elwell, Editor, "Carolina Genes," North Carolina Biotechnology Center, Box 13547, Research Triangle Park, Inc., 27709-3547 (phone 919-541-9366; FAX 919-990-9544; e-mail l_elwell@ncbiotech.org). "DNA On Trial, Genetic Identification and Criminal Justice," edited by Paul R. Billings (1992) is available for purchase from Cold Spring Harbor Laboratory Press, 10 Skyline Drive, Plainview, New York 11803 (phone 800-843-4388; FAX 516-349-1946). The book provides an overview of how DNA information has been presented in actual criminal and civil courtroom settings by prosecutors, expert scientists, physicians, and biotechnology companies. It covers problems that result when the public is undereducated about genetics and the new technology. Public policy issues of privacy, civil rights, and ethics are also covered in detail.

PLANNING FOR WORKSHOP IN FULL SWING

Mike Zeller, Biology Instructor from Woodward-Granger High School, and Jay Staker, Biology Instructor from Ballard High School, Huxley, will be instructors for a biotechnology workshop to be held at Hoover High School, 4800 Aurora Avenue in Des Moines on August 14 - 16. These instructors will help teachers prepare to teach biotechnology in the classroom setting using the kits for DNA isolation, transformation, and fingerprinting provided by the Office of Biotechnology at Iowa State University. Guest lecturers will introduce the workshop attendees to various biotechnology applications, including those in human health, agriculture, and foods.

Zeller and Staker also plan to introduce the teachers to kits for DNA amplification by Polymerase Chain Reaction (PCR) that are available from Carolina Biological Supply. One kit requires a thermocycler, but the other procedure may be done in a classroom setting using water baths. In the next issue of the Iowa Biotech Educator, Staker and Zeller will be writing an article about these particular kits.

To register for the workshop, contact Mike Zeller, Woodward-Granger High School, 306 West 3rd St., Woodward, IA 50276 (phone 515-438-2115, FAX 515-438-4329, e-mail zeller@iowanet.mste.org).

UPDATE ON BIOTECH NETWORKS

PSInet

Recent information posted on PSInet includes:

- An article on "hot" biotech jobs from "Genetic Engineering News" (January 1995) and an article on employment trends in biotechnology from the "Genetic Engineering News Biotech Directory."
- A notice that the following magazine articles might interest educators and their students:
  - Spaulding, Sally, "Knowing Isn't Everything,' Genetic Testing Is Important But So Are The People Affected," "Newsweek," April 3, 1995. (Spaulding writes about how Huntington's disease has affected her own life.)

This issue includes information about how patents and intellectual property rights affect
agricultural and biotechnology research and product development. It also has news from Washington, D.C., that affects biotech industries and information on Calgene's problems with packing and shipping FLAVR SAVR (TM) tomatoes. Two news releases from Monsanto on biotech products: One is about the Environmental Protection Agency (EPA) approval for full commercialization of Monsanto's New Leaf potato, a plant pesticide containing genetic material needed to make a small quantity of insecticide that is toxic to the Colorado potato beetle and nontoxic to mammals, birds, and most other insects. The other is about the EPA's approval of a label to allow the spraying of Roundup herbicide over Roundup Ready soybeans during the growing season. Roundup Ready soybeans are tolerant to the herbicide and under-development by leading seed company partners of Monsanto.

News releases on recent research developments at Iowa State University. For more information, contact Lori Miller, Office of Biotechnology, ISU, 1210 Molecular Biology Building, Ames, IA 50011 (phone 515-294-9818 or 1-800-262-0015, ext. 9818 (in Iowa), FAX 515-294-4629, e-mail l_miller@molebio.iastate.edu).

America On-Line (AOL) Jeff Weld, Iowa Access Excellence Fellow, reports that "Access Excellence" has assembled a second group of Fellows with the help of a National Science Teacher Association Teacher selection committee. After a second summit is held in July, over 200 teachers will have been officially involved with the project. Access Excellence is now accessible directly on the World Wide Web of the Internet at http://www.gene.com/ae. The National Association of Biology Teachers, the National Science Teacher Association and Carolina Biological Supply are on-line resources in the "Resource Center" icon. Under the icon "About Biotech," a new option to explore biotech news is featured. (Select "Biotech News on AOL.") This month's seminar host is Genentech scientist Dr. Ivan Kljavin who is fielding questions on photoreceptor research. For more information, you may contact Weld at Pella High School, 212 E. University, Pella, IA 50219 (phone 515-628-3879, FAX 515-628-9319, e-mail AEJweld@aol.com).

PERMANENT BIOTECHNOLOGY EXHIBITS ARE ESTABLISHED IN WASHINGTON, D.C., AND ST. LOUIS The Smithsonian Institution in Washington, D.C., exhibit, "Science in American Life," is located at the National Museum of American History. It offers a 1,500-square-foot interactive educational center where visitors learn science by hands-on activities. Among the hands-on activities, you will find DNA fingerprinting, water sample testing, and beverage food dye separation. The exhibit explores science from the earliest chemical laboratory in an American university to the newest frontiers of biotechnology. One room of the exhibit, "Looking Ahead," is devoted exclusively to biotechnology. There also is an educational resource corner at the exhibit featuring multimedia curriculum materials for grades K-12. You may contact the Education and Visitor Services at 202-357-1481, if you wish to set up a guided tour for a group.

The St. Louis Science Center in St. Louis, Missouri, features a 2,000-square-foot Gene Scene Gallery on many aspects of biotechnology. Gregor Mendel's discoveries on the principles of heredity are featured in one exhibit. In another, visitors tour the "inside of a talking three-dimensional cell" and view "cell division." Visitors see a giant DNA model and learn about DNA in "designer gene" activities. Visitors are also introduced to new developments in genetic research under the microscope, at computer stations, and in miniature greenhouses. Slides and video presentations
on various aspects of biotechnology are available for viewing. If you would like more information, contact the Science Center at 314-289-4444. TIPS FOR TEACHERS Tip #1 is from Mike Zeller, Biology Teacher at Woodward-Granger High School. Zeller says he’s always looking for ways to answer students' questions about the relatively new science of biotechnology. Zeller began teaching biotechnology to high school students in an experimental summer program in 1989 at Woodward-Granger High School. Two years ago, his school made this course a permanent option during the regular school year. For several years, Zeller has also been teaching educators how to teach biotechnology in the classroom. Tip #2 is from Kris Howes-Vonstein, a biology teacher at Washington High School in the Vinton-Shellsburg Community School District. Howes-Vonstein's biology class hosted a "Biotechnology Conference" complete with poster presentations. "Students became interested in a wide variety of biotechnology topics because of the conference and it provided an excellent opportunity for them to practice communication and research skills as well," Howes-Vonstein said. Tip #1 by Mike Zeller, Biology Teacher, Woodward-Granger High School, 306 West 3rd St., Woodward, IA 50276 (Phone 515-438-2115, FAX 515-438-4329, e-mail Zeller@iowanet.mste.org).

Seven years ago, when I started my school's DNA science course, a very astute student asked, "Mr. Zeller, by changing the DNA of organisms, aren't we playing God?" I was not prepared to answer the question very well at that time, even though I did give the student an answer. The fact that my students were concerned with this concept made me aware of preconceived notions students were bringing to the classroom about the new science of biotechnology. I wanted to be more prepared to answer such questions, so I searched for a laboratory or an activity that would help me explain the natural change of DNA that takes place in organisms. I ended up adapting a microbiology lab I had used in college. The lab not only helps answer students' questions, but it helps prepare them for future lessons on industrial applications of bacteria and the role of bacteria in disease. I use this lab before the DNA transformation lab from the Office of Biotechnology at Iowa State University so students will see that natural, random mutations occurring in the DNA of bacteria can cause antibiotic resistance. This lab allows them to see some of the special qualities DNA has in nature and helps me explain why we "aren't playing God." The students realize we're "playing human" when we do the later DNA transformation exercises. They see them as applications of what we learned from nature. I use the following lab to introduce my students to three important concepts about bacterial DNA: 1. Bacterial DNA has natural random changes that makes it resistant to an antibiotic. 2. The DNA transformation exercise only enhances what naturally occurs in normal bacterial populations. 3. It is possible to use the concept of evolution to explain how disease causing bacteria can become resistant to an antibiotic. ABERRATION OF BACTERIAL DNA: HOW DISEASES BECOME ANTIBIOTIC RESISTANT INTRODUCTION During the normal growth of a bacterial culture, some cells develop with an aberration in their DNA. It is likely that some alteration occurred in assembling the nucleotide sequence. Such cells are mutants, and if they are able to grow in the environment that they are provided, the altered DNA is reproduced in successive generations. Consequently, these organisms exhibit some characteristics that differ from the parent strain. In normal populations, the incidence of mutants is very low (e.g., 1 to 10,000 or 1 in 1,000,000). Since bacterial cultures ordinarily reach populations in the hundreds of
millions or billions, an appreciable number of mutants are produced. The fate of these mutants is determined by their ability to survive in the environment in which the mutation occurs. In many instances, environmental conditions are less favorable for the mutant than for the parent strain, and the mutant is crowded out. In the following investigation, you will attempt to isolate ampicillin-resistant strains (mutants) of Escherichia coli from a parent strain that is ampicillin sensitive. The day before the experiment actually begins, you will prepare an overnight culture suspension using the following procedure: (NOTE: The teacher can prepare the overnight suspension and the gradient slant plates the day before the investigation or have the students do this to gain experience with the techniques. I highly recommend having students do both these parts. All lab procedures should be done under sterile conditions with sterile equipment. Dry sterilization of equipment that is not plastic may be done by wrapping the equipment in aluminum foil and placing it in a 350 degree F oven for 20 minutes. Plastic equipment can be sterilized by the same method in a 250 degree F oven for 30 minutes. Media can be prepared ahead of time and refrigerated. Melt the agar later, using a microwave as needed.)

DAY ONE: OVERNIGHT CULTURE SUSPENSION

MATERIALS

MM294 strain of E.coli plate freshly streaked (less than a week old)  
Sterile Luria broth (LB) 10% bleach 37 degree C shaking water bath or magnetic stirrer in an incubator  
(Shaking periodically by hand in an incubator also works.)  
Innoculating loop  
Sterile 10 ml pipet  
Pipet (10 ml or greater)  
Bunsen burner  
Sterile 50 ml conical tube  
Permanent marker  
Safety equipment (gloves, apron, goggles)

PROCEDURES

1. Label a sterile 50 ml conical tube with your name and today’s date. The large tube provides a large surface for good aeration of the culture.  
2. Use a sterile 10 ml pipet to steriley transfer 5 ml of Luria broth into the conical tube.  
3. Using a sterile inoculating loop, locate a well defined colony (1-4 mm in diameter) on the freshly streaked plate and scrape up a visible cell mass.  
4. Sterilely transfer the cell mass to the conical tube with the Luria broth.  
5. Loosely replace the cap on the conical tube to allow air to flow to the culture. Place a piece of tape over the cap to prevent it from falling off and contaminating the culture.  
6. Incube 18 to 24 hours at 37 degree C. Continuous agitation is best during incubation, but not absolutely necessary. If you incubate without shaking, incubate at least 24 hours longer.  

DAY TWO

MATERIALS

100 ml Luria broth agar (50 degree C)  
Permanent markers  
Overnight suspension E.coli culture  
2 sterile petri dishes per group  
100 ml Luria broth agar (50 degree C) + ampicillin  
Spreadr (2-sterile bent paper clips)  
1% ampicillin solution  
2-1 ml pipet and appropriate pump  
10% bleach  
37 degree C incubator  
Ethanol  
Bunsen burner

PROCEDURES

Prepare two ampicillin gradient Luria broth agar plates according to the following directions:  
1. Elevate one side of the plates so that the medium is in a thin layer on one side and a thick layer on the other side.  
2. Using sterile technique, pour Luria broth agar that has cooled (50 degree C) into the two petri dishes.  
3. When the first layer of medium solidifies, place the plates on a horizontal surface and sterilely pour in the Luria broth agar containing ampicillin over the first layer. Allow the medium to solidify. After the agar has solidified, mark the bottom of your agar plates with the letter A on the thick ampicillin agar side. (The ampicillin will establish a concentration gradient across the plates. The high concentration of
ampicillin will be located where the ampicillin agar is thickest. The low concentration will be on the opposite side.) 4. Place the agar plates in the 37 degree C incubator for approximately 1 hour or let it sit on the lab table overnight to reduce surface moisture. DAY THREE PROCEDURES 5. Using a 1 ml pipet and pump, steriley place 0.1 ml (100 l) of the E.coli overnight suspension culture on the agar surface and spread it out uniformly over the entire surface with a sterile rod spreader or a paper clip that has been bent in the form of a bacteria spreader. The rod should be flamed by dipping it into ethanol and then lighting it. Wait for the flame to die out before spreading the overnight suspension. It is important that the surface be uniformly covered and completely incubated. 6. Incubate the plates for 1 to 2 days and look for the presence of isolated colonies in the region of the high ampicillin concentration. STUDENT ANALYSIS 1. Make detailed observations of your plate after 24 hours and after 48 hours. 2. Why is 37 degree C the optimum temperature for E.coli? 3. Give two reasons why it is ideal to continuously shake a suspension culture. 4. What growth phase is reached by a suspension of E.Coli following overnight shaking at 37 degree C? 5. Make a data table for the number of colonies and their location on your gradient agar plates. 6. Explain how a mutant strain of bacteria could be formed in the culture tube. 7. Explain your results in a phenotypical manner. 8. Using the concept of evolution, explain how this lab shows the development of a bacterial strain that is resistant to antibiotics? Tip #2 by Kris-Howes Vonstein, Washington High School, Vinton-Shellsburg Community School, 212 West 15th St., Vinton, IA 52349 (phone 319-472-4723; FAX 319-472-4721). To motivate my students and add realism to the subject of biotechnology, I had my students host a Biotechnology Conference at the high school. I prepared a conference brochure inviting them to participate and register for the event. The brochure provided basic information on the conference's theme, its location and date, and a registration form. I told the students about conferences and posters sessions that I had personally attended to give them an idea of what I expected. Students registered for the conference by choosing a "company name" and a biotechnology topic. Each team of four students had specific responsibilities that they had to complete during the week before the conference. The keynote speaker team had to find a guest speaker for their class. I told them, if they could not find someone to come on the day of the conference, they would have to interview someone and role play the keynote address. All my classes did pick keynote speakers. Keynote speakers who came to the event were Eric Von Muenester, a sales and educational representative from Pioneer Hi-Bred at Dysart; Iris Vern, an industrial biotechnologist from Genencor at Cedar Rapids; and Jay Horton, a Research Assistant at the University of Iowa for the Program for Biomedical Ethics and Medical Humanities. Horton's main responsibility is to work on the ethical, legal, and social implications of the University's Genome Center. The keynote speaker team also prepared a brochure about biotechnology careers. They based it on Careers in Biotechnology (NCR #483), an Office of Biotechnology at Iowa State University Biotechnology Information Series bulletin, that may be ordered from Extension Distribution Center, 119 Printing and Publications Building, Iowa State University, Ames, IA 50011 (phone 515-294-5247). The steering committee organized the library for the event and gave the welcoming speech on the conference theme: "Biotechnology Today Will Shape Our World Tomorrow." This committee also planned refreshments, a big hit with high school students. Other teams prepared posters on various biotechnology topics. The
students used the library to research their topics and telephoned
universities, businesses and hospitals for further information. I gave
them copies of the 10 easy-to-read bulletins written for the non-
scientist from the Biotechnology Information Series that were prepared
by the Office of Biotechnology at Iowa State University and available
from the Extension Distribution Center. This series is a very valuable
source of biotechnology information. Students from study
halls were came to see the posters and listen to the speakers.
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I was impressed by how well student-presenters and attendees behaved. My
biology students worked hard on their posters and projects and
enthusiastically presented their posters to their classmates. You
could easily see they had captured their audience's interest because of
the thoughtful questions their classmates posed. The keynote speakers
commented on the quality of the project and were happy to participate.
When I repeat this conference, I plan to open it to the community. I
would like to host an open house on the night of a school conference.
The posters were so informative and well prepared that I want them to
be shared with the public. OUTREACH PROGRAM The Public Education
Program in Biotechnology is supported by the Iowa Soybean Promotion
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